NISTTech

Micron-Scale Differential Scanning Calorimeter on a Chip

Perform better microcaloric measurements using scanning microcalorimeters

Description

This scanning microcalorimeter on a chip measures the changes in heat of small samples and thin films or monolayer films over a large range of temperatures. A sample or sensing material is placed on the sample zone. As the temperature is scanned, a loss or gain of heat associated with a reaction or phase transition in the sample zone results in the production of a difference signal. Mapping the difference over a range of temperature provides information about the reaction.

The microcalorimeter chip is produced using a conventional complementary metal oxide semiconductor (CMOS) process with silicon oxide, polysilicon, and aluminum layers. Other types of substrate materials such as gallium arsenide coupled with appropriate dielectrics and thermocouple metals may be used. Amplifying and switching devices can be integrated into the microcalorimeter.

Applications

- **Biochemistry and thin films**
  Customized temperature steps and pulse scans may be used to enhance the detection of chemical species.
- **Can measure various types of materials including:**
  Catalysts for chemical sensing, materials that exhibit phase transitions, and chemically selctive reactive materials.
- **DNA diagnostics**
  An array of microcalorimeters would be placed inside an oven and each array would be coated with a specific DNA sequence. Hybridization to the array elements could be observed via calorimetric difference signals as the array is heated to the corresponding hybridizing temperatures.

Advantages

- **Improved Measurements**
  Effective thermal isolation.
- **Expanded uses**
  A sensing principle based on the detection of voltage changes due to

thermal changes in the sample zone.

- **Design**
  Both the reference and sample areas are close together and thereby encounter the same environment.

Abstract

A differential scanning microcalorimeter produced on a silicon chip enables microscopic scanning calorimetry measurements of small samples and thin films. The chip may be fabricated using standard CMOS processes. The microcalorimeter includes a reference zone and a sample zone. The reference and sample zones may be at opposite ends of a suspended platform or may reside on separate platforms. An integrated polysilicon heater provides heat to each zone. A thermopile consisting of a succession of thermocouple junctions generates a voltage representing the temperature difference between the reference and sample zones. Temperature differences between the zones provide information about the chemical reactions and phase transitions that occur in a sample placed in the sample zone.

Inventors

- Cavicchi, Richard E.
- Gaitan, Michael
- Poirier, Gregory E.
- Suehle, John
- Tea, Nim H.

References

- U.S. Patent # 6,079,873
- Docket: 97-038US

Status of Availability

This invention is available for licensing.

Last Modified: 02/25/2011